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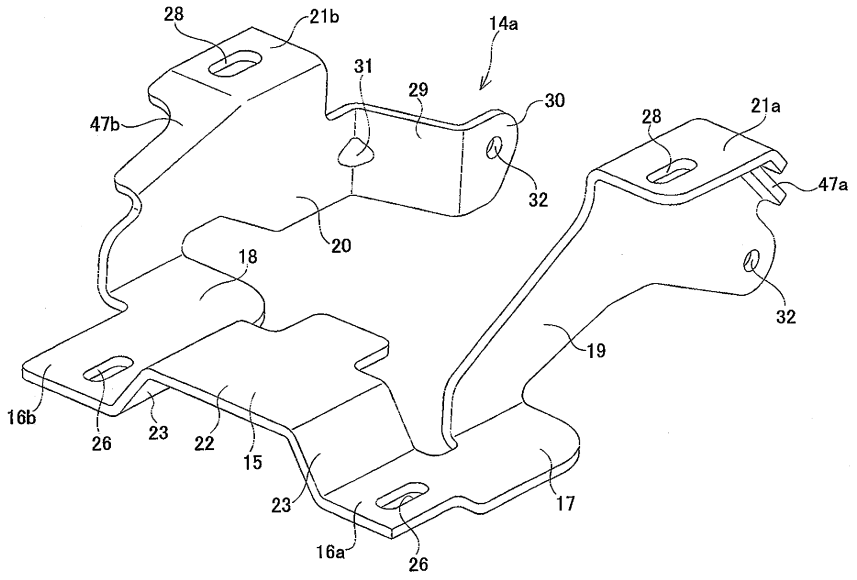
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(54) SUPPORT BRACKET, METHOD FOR MANUFACTURING SUPPORT BRACKET, AND ELECTRIC POWER STEERING DEVICE USING SUPPORT BRACKET

(57) A support bracket structure is realized, in which the support bracket is made using a metal plate and sufficient strength and rigidity thereof can be maintained, and the production costs thereof can be kept sufficiently low by improving the yield of material. A support bracket 14a for supporting the front end section of a steering column 6a by way of a housing 9a of an electric power-steering apparatus is manufactured by using a press to punch out and bend a metal plate. By devising the dimensions and bending direction of each part, the yield of material is improved, while at the same time the height dimensions of the first side plate section 19 and the second side plate section 20 required for maintaining the support rigidity under a heavy load is maintained.

Fig.1



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Description

TECHNICAL FIELD

[0001] The present invention relates to an electric-power steering apparatus, and particularly to a support bracket by which a vehicle supports a steering column of this electric power-steering apparatus.

BACKGROUND ART

[0002] The use of electric power-steering apparatuses is widely spread as a steering apparatus for applying a steering angle to the steered wheels of an automobile, and that uses an electric motor as a drive source to reduce the steering force. FIG. 14 illustrates an example of a conventional electric power-steering apparatus that is disclosed in JP 2011-131682 (A). In this structure, the rotation of a steering wheel 1 is transmitted to an input shaft 3 of a steering gear unit 2, and as the input shaft 3 rotates, a pair of left and right tie rods 4 are pushed or pulled, which applies a steering angle to steered wheels. The steering wheel 1 is supported by and fastened to the rear end section of a steering shaft 5, and this steering shaft 5 is inserted in the axial direction through a cylindrical steering column 6, and supported by this steering column 6 so as to be able to freely rotate. Moreover, the front end section of the steering shaft 5 is connected to the rear end section of an intermediate shaft 8 by way of a universal joint 7a, and the front end of this intermediate shaft 8 is connected to the input shaft 3 by way of another universal joint 7b. The forward-backward direction and the width direction in this specification mean the forward-backward direction and the width direction of the vehicle when the steering apparatus is assembled in the vehicle, and left and right in the width direction means the left and right with respect to the direction of travel when the vehicle is traveling in the forward direction.

[0003] The front end section of the steering column 6 is connected to a housing 9 of the electric power-steering apparatus. Component parts of the electric power-steering apparatus such as a torque detector, a worn reduction gear and the like are housed inside this housing 9, and an electric motor 10, which is an auxiliary power source of the electric power-steering apparatus, is supported by the outside surface of this housing 9. Moreover, in order to construct a tilt mechanism for adjusting the height position of the steering wheel 1, the housing 9 is supported by the vehicle body 11 so as to be able to pivotally displace around a pivot shaft 12 that is arranged in the width direction of the vehicle, and the a portion on the rear side of the intermediate section of the steering column 6 is supported by a rear support bracket 13 that is supported by the vehicle body 11 such that the up-down position can be adjusted. In regards to the detailed structure of this tilt mechanism, various kinds of structures are known, and because the adjustment mechanism for adjusting the up-down position with respect to the rear support bracket 13 is not related to the main feature of the present invention, detailed drawings and explanations are omitted.

[0004] As described above, in order to construct an electric power-steering apparatus that comprises a tilt mechanism, the housing 9 that is connected to the front end section of the steering column 6 must be supported by the vehicle body 11 so as to be able to pivotally displace around a pivot shaftb12 that is arranged in the width direction. Therefore, it is necessary that a support bracket 14 be fastened to the vehicle body 11, and that this support bracket 14 and housing 9 be connected by the pivot shaft 12. The support bracket 14 supports the front end section of the steering column 6 by way of the housing 9 in or to which the component parts of the electric power-steering apparatus are housed or mounted, so it is necessary that the strength and rigidity of the support bracket 14 be sufficiently large. On the other hand, in order to suppress manufacturing costs of an electric power-steering apparatus that comprises a tilt mechanism, preferably this support bracket 14 is made by using a press to punch and bend a metal plate such as steel plate having the required strength and rigidity, such as disclosed in JP 2005-219641 (A). However, when trying to make the support bracket 14 using a metal plate, while at the same time maintain the required strength and rigidity, the cutting stock is insufficient, and it is easy for the metal plate material to be wasted. In order to keep the manufacturing costs of the support bracket 14 low, it is necessary to effectively use the metal plate and to improve the material yield. However, a support bracket made using a metal plate having structure that can meet these needs has not been achieved yet.

[Related Literature]

[Patent Literature]

[0005]

[Patent Literature 1] JP 2011-181682 (A)
[Patent Literature 2] JP 2005-219641 (A)

SUMMARY OF THE INVENTION

[Problem to be Solved by the Invention]

[0006] Taking the above situation into consideration, the object of the present invention is to provide a support bracket that is made using a metal plate and is capable of maintaining sufficient strength and rigidity, as well as can be manufactured with good material yield and sufficiently low cost.

[Means for Solving the Problems]

[0007] The present invention relates to a support bracket for supporting a steering column on a vehicle

body together with a housing in which and on which components of an electric power-steering apparatus are housed or mounted. The support bracket of the present invention is made by punching and bending a metal plate into a single piece having a left and right asymmetrical shape.

[0008] The support bracket of the present invention is characterized by comprising: a base plate section that is provided in the width direction on the rear end section of the support bracket; a pair of left and right rear installation plate sections that are provided on both end sections in the width direction of the base plate section; a first extended section and a second extended section that extend forward from the edge on the front end of these rear installation plate sections; a first side plate section that is bent upward from the edge on the inside in the width direction of the first extended section; a second side plate section that is bent upward from the edge on the outside in the width direction of the second extended section; a first front installation plate section that is provided in a state of being bent outward in the width direction from the edge on the top end of the first side plate section; and a second front installation plate section that is provided in a state of being bent outward in the width direction from the edge on the top end of the second side plate section.

[0009] Preferably, the support bracket of the present invention further comprises: a first reinforcement plate section that extends downward toward the front from the edge on the front end of the first front installation plate section, and has an edge on the rear end that is continuous to the edge on the front end of the first front installation section by way of a bent section, and an edge on the end in the width direction that is continuous to the edge on the top end of the first side plate section by way of a bend section; and a second reinforcement plate section that extends downward toward the rear from the edge on the rear end of the second front installation plate section, and has an edge on the front end that is continuous to the edge on the rear end of the second front installation plate section by way of a bent section, and an edge on the end in the width direction that is continuous to the edge on the top end of the second side plate section by way of a bent section.

[0010] As the structure for supporting the steering column, in the first example, circular holes for supporting a pivot shaft for supporting the steering column are formed in the front end sections of the first side plate section and second side plate section.

[0011] Preferably, the front end section of the second side plate section is offset inward in the width direction, and the space between the front end sections of the first side plate section and second side plate section is more narrow than the space between the middle sections and rear sections of the first side plate section and the second side plate section.

[0012] In this case, preferably, the front end section of the second side plate section is continuous with the middle section in the forward-backward direction of the second side plate section by way of an inclined plate section, and a reinforcement rib that protrudes inward in the bending direction is provided in the middle section in the up-down direction of the bent section where the middle section of the second side plate section and the inclined plate section are continuous.

[0013] The support bracket of the present invention can be manufactured by a manufacturing method that comprises a first process of forming an intermediate material that has an overall flat shape by stamping out this intermediate material from a raw material that has a flat shape; and a second process of bending this intermediate material.

[0014] More specifically, in the first process, the intermediate material that has an overall flat shape is formed that comprises: a raw base plate section that exists in a portion that corresponds to the base plate section; a first raw extended section and a second raw extended section that extend forward from the edge on the front end of the end sections on both the left and right sides of the raw base plate section; a first raw side plate section that extends from the edge on the inside in the width direction of the first raw extended section to the center side in the width direction; and a second raw side plate section that extends from the edge on the outside in the width direction of the second raw extended section to the outside in the width direction.

[0015] Next, in the second process, the base end section of the first raw side plate section is bent with respect to the first raw extended section, and the base end section of the second raw side plate section is bent with respect to the second raw extended section in the same direction in the thickness direction of the intermediate material at right angles to form the first side plate section and second side plate section, and the end sections in the width direction of the first side plate section and second side plate section are bent to the outside in the width direction of the intermediate material in opposite directions from each other to form the first front installation plate section and the second installation plate section.

[0016] In this case, preferably, with reference to the width direction of the intermediate material, the distance from the bent section between the base end section of the first raw side plate section and the first raw extended section to the edge on the inside in the width direction of the first raw side plate section is greater than the distance from the bent section between the base end section of the second raw side plate section and the second raw extended section to the edge on the outside in the width direction of the second raw side plate section.

[0017] The electric power-steering apparatus of the present invention comprises: a steering column; a housing that is connected to the front end section of the steering column and in which or on which components of the electric power-steering apparatus are mounted; and a support bracket that supports and fastens the front end section of the steering column to the vehicle body togeth-

er with the housing. Particularly, in the electric power-steering apparatus of the present invention, the support bracket of the present invention is used as the support bracket

[0018] In this case, preferably the front end section of the steering column is supported by a pivot shaft that spans between the front end sections of the first side plate section and second side plate section so as to be able to pivotally displace with respect to the vehicle body.

[0019] Moreover, in the support bracket, the front end section of the second side plate section is offset inward in the width direction, and the space between the front end sections of the first side plate section and the second side plate section is more narrow than the space between the middle sections and the rear sections of the first side plate section and second side plate section, and the component parts are arranged in a space between the middle sections and the rear sections of the first side plate section and the second side plate section that has a larger space in the width direction.

[0020] Furthermore, preferably the component parts are located at a position offset more toward the side of the second side plate section than the center position in the width direction of the space between the first side plate section and the second side plate section.

[Effect of the Invention]

[0021] With the present invention, it is possible to manufacture at low cost a support bracket having necessary strength and rigidity, as well as good blanking characteristics More specifically, the bending directions of the first side plate section and the second side plate section with respect to the first extended section and second extended section of the support bracket are devised so as to be in the same direction in the intermediate material stage, so it is possible in the intermediate material stage to use the material existing between the first extended section and the second extended section efficiently, while maintaining the width dimensions in the up-down direction of the first side plate section and the second side plate section, Therefore, it is possible to maintain yield of the metal plate, and keep the costs of manufacturing the support bracket low.

[0022] Moreover, the height dimensions in the up-down direction of the first side plate section and the second side plate section are maintained, so the strength and rigidity of the support bracket of the present invention under loading in this direction is high. Therefore, when a pivot shaft spans between the front end sections of the first side plate section and the second side plate section, it is possible for the support bracket of the present invention to sufficiently support the weight of the components of the steering column and electric power-steering apparatus that is applied by way of the pivot shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG.1 is a perspective drawing illustrating a support bracket that is assembled in a first example of an embodiment of the present invention, and is a view as seen diagonally from above in the rear.

FIG. 2 is a perspective drawing illustrating the support bracket illustrated in FIG 1, and is a view as seen from the opposite side in the width direction of that in FIG 1.

FIG. 3 is a top view of the support bracket illustrated in FIG. 1

FIG. 4 is a left side view of the support bracket illustrated in FIG. 1.

FIG. 5 is a right side view of the support bracket illustrated in FIG. 1.

FIG. 6 is rear view of the supports bracket illustrated in FIG. 1, and illustrates the stat as seen from the right in FIG. 4.

FIG 7 is a top view illustrating a first step for manufacturing the support bracket illustrated in FIG. 1, and illustrates the intermediate material that is obtained by stamping out it from a metal plate.

FIG. 8 is a perspective drawing illustrating an electric power-steering apparatus in which the support bracket illustrated in FIG. 1 is assembled, and is a view as seen diagonally from underneath of the left rear

FIG. 9 is a left side view of the electric power-steering apparatus illustrated in FIG. 8.

FIG. 10 is a rear view of the electric power-steering apparatus illustrated in FIG. 8 as seen from the right in FIG. 9.

FIG. 11 is a front view of the electric power-steering apparatus illustrated in FIG. 8 as seen from the left in FIG. 9.

FIG 12 is a left side view illustrating an electric power-steering apparatus before the support bracket illustrated in FIG. 1 is assembled.

FIG. 13 is a top view for explaining the positional relationship of the component members of the electric power-steering apparatus and the support bracket that supports the front end section of the steering column, and is a view as seen from the same direction as in FIG. 3.

FIG. 14 is a partial cross-sectional side view illustrating an example of a conventional electric power-steering apparatus

MODES FOR CARRYING OUT THE INVENTION

[0024] FIG. 1 to FIG. 13 illustrate an example of an embodiment of the present invention Including this example, a feature of the present invention is the structure of a support bracket 14a for supporting a steering column 6a together with a housing 9a that supports components

of an electric power-steering apparatus by a vehicle body 11 (see FIG. 14), and the manufacturing method thereof The other basic structure of the electric power-steering apparatus is the same as in a conventional apparatus.

[0025] The support bracket 14a is made by using a press to perform punching and bending of a metal plate such as steel plate or stainless steel plate for which it is possible to maintain sufficient strength and rigidity, and forming the bracket into a single piece with a left and right asymmetrical shape. The thickness of the metal plate is appropriately selected by comprehensively determining the strength, rigidity and ease of processing according to the material used, for example, the thickness is about 2.0 mm to 4.0 mm in the case of using a stainless steel plate such as SUS 304. This kind of support bracket 14a comprises a base plate section 15, a pair of left and right rear installation plate sections 16a, 16b, a first extended section 17, a second extended section 18, a first side plate section 19, a second side plate section 20 and a pair of left and right front installation plate section 21a, 21b.

[0026] Of these, the base plate section 15 is provided on the rear end section of the support bracket 14a in the width direction, and comprises a flat plate section 22 in the center in the width direction, and a pair of left and right inclined plate sections 23 that are continuous outward in the width direction from the edges of the ends on both sides in the width direction of the flat plate section 22 and incline downward in a direction going away from the flat plate section 22, with the overall shape of the base plate section 15 being mountain shaped. The portions continuous from the edges on the outside ends in the width direction of these inclined plate sections 23 are the first rear installation plate section 16a and the second rear installation plate section 16b.

[0027] The inclined plate sections 23 are bent upward and continue at an angle from the edges on the inside ends in the width direction of these rear installation plate sections 16a, 16b, so the bending rigidity of the rear installation plate sections 16a, 16b is sufficiently maintained. These rear installation plate sections 16a, 16b and the flat plate section 22 are parallel with each other These rear installation plate sections 16a, 16b are for supporting and fastening the supports bracket 14a to the vehicle body 11, and are for supporting the column support bracket 24 (see FIG. 8 to FIG 10) so as to be able to break away in the forward direction with respect to the support bracket 14a during a secondary collision. Having this kind of function, a pair of through holes 26 through which bolts 25 (see FIG. 14) or studs are passed, are formed in the real installation plate sections 16a, 16b. These through holes 26 are long holes that are long in the forward-backward direction so as to make the work of installing the support bracket 14a to the vehicle body 11 easy and do not necessarily need high processing precision, As described above, the bending rigidity of the rear installation plate sections 16a, 16b is sufficiently high, so by using these rear installation plate section, it is possible to increase both the support rigidity of the support bracket 14a with respect to the vehicle body 11, and the support rigidity of the column support bracket 24 with respect to this support bracket 14a.

[0028] In addition, the first extended section 17 and the second extended section 18 extend toward the front from the edges on the front ends of the first rear installation plate section 16a and the second rear installation plate section 16b respectively. The base end sections (back end sections) of the first side plate section 19 and the second side plate section 20 are bent upward at right angles from the side edges (the left side edges in the width direction in this example) of the first extended section 17 and the second extended section 18, and the middle sections and the tip ends sections (front end sections) thereof extend even further in the forward direction than the edges on the front ends of the first extended section 17 and the second extended section 18.

[0029] With reference to the width direction (left-right direction) of the support bracket 14a, the first side plate section 19 and the second side plate section 20 bend upward from the side edges of the same sides of the first extended section 17 and the second extended section 18 (in opposite directions with respect to inward and outward direction, and in this example, on the left side in the width direction). In other words, the base end section of the first side plate section 19 is bent upward at a right angle from the edge on the inside in the width direction of the first extended section 17. On the other hand, the second side plate section 20 is bent upward at a right angle from the edge on the outside in the width direction of the second extended section 18. By sufficiently maintaining the height dimension in the up-down direction of the first side plate section 19 and the second side plate section 20, the strength and rigidity in the up-down direction of the supports bracket 14a is sufficiently maintained. More specifically, as illustrated in FIG. 4 and FIG 5, with respect to the dimension in the up-down direction of' the support bracket 14a, when the distance between an imaginary flat plane on the bottom side that includes the bottom surface of the rear installation plate sections 16a, 16b, and an imaginary flat plane on the top side that includes the top surface of the front installation plate section 21a of the front installation plate sections 21a, 21b that is located on the upper side corresponds to the height dimension H of the support bracket 14a, preferably the ratio of the height dimensions h_{19}, h_{20} of the portions of the first side plate section 19 and the second side plate section 20 that include the front installation plate sections 21a, 21b to the height dimension H of the support bracket 14a is 2/3 or greater ($h_{19} \geq 2H/3$, $h_{20} \geq 2H/3$). However, depending on the arrangement of the surrounding parts, this ratio can be arbitrarily set within a range where the strength and rigidity of the support bracket 14a can be maintained.

[0030] Moreover, the edges on the top end of the first side plate section 19 and the second side plate section 20 are bent outward in the width direction of the support

bracket 14a at right angles in the opposite directions from each other to form the first front installation plate section 21a and the second front installation plate section 21b. These front installation plate sections 21a, 21b are for supporting and fastening the support bracket 14a to the vehicle body 11, and through holes 28 though which boles or studs (not illustrated in the figure) are passed are formed in each. These through holes 28 as well are long holes that are long in the forward-backward direction so as to make the work of installing the supports bracket 14a to the vehicle body 11 easy and do not necessarily need high processing precision Moreover, a first reinforcement plate section 47a that extends downward toward the front from the edge on the front end of the first front installation plate section 21a, and a second reinforcement plate section 47b that extends downward toward the rear from the edge on the rear end of the second front installation plate section 21b are formed The edge on the rear end of the first reinforcement plate section 47a is continuous by way of a bent section with the edge on the front end of the first installation plate section 21a, and the edge on the inside end in the width direction is continuous by way of a bent section with the edge on the top end of the first side plate section 19 respectively. The edge on the front end of the second reinforcement plate section 47b is continuous by way of a bent section with the edge on the rear end of the second front installation plate section 21b, and the edge on the inside end in the width direction is continuous by way of a bent section with the edge on the top end of the second side plate section 20 respectively Therefore, it is possible to sufficiently increase the strength and rigidity, and particularly the bending rigidity, of the front installation plate sections 21a, 21b with respect to the first side plate section 19 and second side plate section 20.

[0031] Furthermore, in this example, the tip end section (front end section) of the second side plate section 20 is offset inward in the width direction. In other words, the middle section of the second side plate section 20 is bent inward in the width direction less than 90° and preferably between 60° and 80° to form an inclined plate section 29, and the tip end section of this inclined plate section 29 is bent toward the front at the same angle (so as to become parallel with the rear section of the second side plate section 20) to form a tip end plate section 30. A reinforcement rib 31 that protrudes inward in the bending direction is formed in the middle section in the up-down direction of the continuous section between the rear section of the second side plate section 20 and the inclined plate section 29, and this maintains the bending rigidity of this inclined plate section 29. In this example, by offsetting the tip end section of the second side plate section 20 inward in the width direction in this way, the space between the tip end section of this second side plate section 20 and the tip end section of the first side plate section 19 becomes more narrow than the space between the area from the center sections to the rear sections of these side plate sections 20, 19. In other words, the space between the tip end section of these side plate section 20, 19 is kept just at the size necessary for a pivot shaft 12a (see FIG. 8, FIG. 9 and FIG. 11), which supports the front end section of the steering column 6a (see FIG. 8 to FIG 10, and FIG. 12) so as to be able to span, and the space between the center sections and the rear sections of the side plate sections 19, 20 is maintained at an amount such that the components of the electric power-steering apparatus can be placed Moreover, circular holes 32 for supporting both end sections of the pivot shaft 12a are formed in the tip end sections of the first side plate section 19 and the second side plate section 20 so as to be concentric with each other

[0032] This kind of support bracket 14a is manufactured by sequentially performing the following first process and second process for using a press to punch and bend a raw metal sheet material. In the first process, punching is performed on a flat raw material such as steel plate or stainless steel plate that has been pulled from an uncoiler to form an intermediate material 33 as illustrated in FIG. 7. This intermediate material 33 is in a complete flat plate shape, and comprises a raw base plate section 34, a first raw extended section 35 and a second raw extended section 36, and a first raw side plate section 37 and a second raw side plate section 38.

[0033] The raw base plate section 34 is the portion that will become the base plate section 15 and the rear installation plate sections 16a, 16b, and exists over the width direction in the rear end portion of the intermediate material 33 that corresponds to the base plate section 15. In this example, the through holes 26 in both end sections in the width direction of the raw base plate section 34 are formed by punching at the same time as the intermediate material 33.

[0034] In addition, the first raw extended section 35 and the second raw extended section 36 extend toward the front from the edges on the front ends of the end sections on both the left and right sides of the raw base plate section 34. The shapes of these raw extended sections 35, 36 are the same as the shapes of the first extended section 17 and second extended section 18 of the completed support bracket 14a respectively.

[0035] Moreover, the base end section of the first raw side plate section 37 extends from the edge on the inside in the width direction of the first raw extended section 35 to the center side in the width direction, and the area from the middle section to the tip end section (front end section) extends forward further than this first raw extended section 35.

[0036] Furthermore, the base end section of the second raw side plate section 38 extends from the edge on the outside in the width direction of the second raw extended section 36 to the outside in the width direction, and the area from the middle section to the tip end section (front end section) extends forward further than the second raw extended section 36.

[0037] Additionally, circular holes 32 are formed in the tip end sections of the first raw side plate section 37 and

the section raw side plate section 38 by punching at the same time as the intermediate material 33. However, the through holes 28 are not formed when punching and forming the intermediate material 33, and are formed in the second process described next after the front installation plate sections 21a, 21b and the reinforcement plate sections 47a, 47b are formed, and are formed in these front installation plate sections 21a, 21b.

[0038] After the intermediate material 33 has been formed in the first process, next, in the second process, the raw base plate section 34 is bent at four locations in the width direction to form a mountain shaped base plate section 15. The portions indicated by the chain lines A to D in FIG. 7 are bent at right angles in a specified direction respectively, and the through holes 28 are punched out to form the support bracket 14a.

[0039] The process for forming the raw base plate section 34 into the base plate section 15 is a simple bending process, and the bending directions can be easily understood by comparing FIG. 7 and FIG. 1 to FIG. 6. Moreover, the process for punching out the through holes 28 is performed after the front installation plate sections 21a, 21b are formed, which prevents the shape of the through holes 28 from becoming distorted as the work for forming the front installation plate sections 21a, 21b is performed. The processing method for these through holes 28 can also be easily understood. Furthermore, the tip end half of the second raw side plate section 38 is bent, and again, by comparing FIG 7 and FIG. 1 to FIG. 6 it is possible to easily know the processing direction for forming the inclined plate section 29, tip end plate section 30, and reinforcement rib 31. Therefore, a detailed explanation of the processing method for these parts is omitted

[0040] Next, the method for forming the first side plate section 19, the second side plate 20, the first front installation section 21a, the second front installation section, the first reinforcement section 47a and the second reinforcement section 47b will be explained. In order to form the first side plate section 19 and the second side plate section 20, the portions indicated by the chain lines A and B the first raw side plate section 37 and the second raw side plate section 38 are bent from the first raw extended plate section 35 and second raw extended plate section 36 at right angles in the same direction to the front side in FIG. 7, or in other words, in the thickness direction of the intermediate material 33. As a result, the first side plate section 19 and the second side plate section 20 are formed so as to be parallel to each other Moreover, the end sections in the width direction of the first raw side plate section 37 and the second raw side plate section 38 (first side plate section 19 and second side plate section 20) in the bent state are bent in opposite directions from each other to the outside in the width direction of the intermediate material 33. In other words, the end section in the width direction of the first raw side plate section 37 is bent at a right angle at the portion indicated by the chain line C in FIG. 7 toward the front side in FIG. 7 to form the first front installation plate section 21a and the first reinforcement plate section 47a. Then, the end section in the width direction of the second raw side plate section 38 is bent at a right angle at the portion indicated by the chain line D in FIG. 7 toward the rear side in FIG. 7 to form the second front installation plate section 21b and the second reinforcement plate section 47b. After that, the through holes 28 are formed in these front installation plate sections 21a. 21b respectively to complete the support bracket 24. The order of the process of bending at the portions indicated by the chain lines A and B, and the process of bending at the portions indicated by the chain lines C and D does not matter.

[0041] In this example, the distance L_{37} in the width direction of the intermediate material 33 from the bent section between the base end section of the first raw side plate section 37 and the first raw extended section 35 (chain line A in FIG. 7) to the edge on the inside in the width direction of the first raw side plate section 37 (edge on the left side in FIG. 7) is greater than the distance L_{38} from the bent section between the base end section of the second raw side plate section 38 and the second raw extended section 36 (chain line B in FIG. 7) to the edge on the outside in the width direction of' the second raw side plate section 38 (edge on the left side in FIG 7) ($L_{37} > L_{38}$). The width dimension W of the raw base plate section 34 is sufficiently larger than the distance L_{37} of the first raw side plate section 37 ($W >> L_{37}$), so even when this kind of blanking is performed, there is no interference between the raw side plate sections 37 and 38. Moreover, by keeping the overall width dimension W of the intermediate material 33 small, it is possible to improve the blanking characteristics, or in other words it is possible to reduce the scrapped portions and thus improve the yield of the material.

[0042] In this example, the base end section of the first raw side plate section 37 is extended from the edge on of the inside in the width direction of the first raw extended section 35 to the center side in the width side, and the base end section of the second raw side plate section 38 extends from the edge on the outside in the width direction of the second raw extended section 36 to the outside in the width direction In other words, the first raw side plate section 37 and the second raw side plate section 38 extend in the same direction, and the first raw side plate section 37 that has a particularly large width dimension is formed in the middle section in the width direction of the first raw extended section 35 and second raw extended section 36 (center section of the intermediate material 33). In this way, the good blanking characteristics of the metal plate that will become the raw material is maintained.

[0043] The support bracket 14a having the shape as described above and manufactured as mentioned before supports the front end section of a steering column 6a such as illustrated in FIG. 12 so as to be able to pivotally displace as illustrated in FIG. 8 to FIG. 11. This steering column 6a is such that the front end section of an outer

column 39 on the rear side is fitted and combined with the rear end section of an inner column 40 on the front side so as to be able to displace in the axial direction, and so the overall length can extend or contract. The inner diameter of the outer column 39 near the front end is able to elastically expand and contract, and a long hole 41 in the forward-backward direction that is long in the axial direction is formed in the outer column 39. Moreover, the steering column 6a is such that a housing 9a for housing a reduction gear of an electric power-steering apparatus is connected and fastened to the front end section of the inner column 40. A cylindrical member 42 though which a pivot shaft 12a is to be inserted is supported by and fastened to the housing 9a.

[0044] In order for the vehicle body to support the steering column 6a by way of the support bracket 14a, a column support bracket 24 is supported by the bottom side of the rear installation plate sections 16a, 16b so as to be able to break away in the forward direction due to an impact load that is applied during a secondary collision, and the rear installation plate sections 16a, 16b and the front installation plate sections 21a, 21b are supported by and fastened to the vehicle body 11 (see FIG. 14). Moreover, both end sections of the pivot shaft 12a that is inserted through the cylindrical member 42 are supported in the circular holes 32 that are formed in the front end sections of the first side plate section 19 and the second side plate section 20. As a result, the front end section of the steering column 6a is supported by the support bracket 14a by way of the housing 9a so as to be able to pivotally displace around the center of the pivot shaft 12a. Furthermore, the outer column 39 is supported by the column support bracket 24 by an adjustment rod 44 that is inserted through long holes 43 in the up-down direction that are formed in the column support bracket 24 and the long holes in the forward-backward direction 41. The up-down position and forward-backward position of the outer column 39 with respect to the column support bracket 24, as well as the up-down position and the forward-backward position of the steering wheel 1 (see FIG. 14) that is supported by and fastened to the rear end section of the steering shaft 5a can be adjusted within a range in which the adjustment rod 44 can displace inside the long holes 43 in the up-down direction and the long holes 41 in the forward-backward direction. Allowing or not allowing this adjustment can be switched by operating an adjustment lever 45 that is provided on the end section of the adjustment rod 44. Various structures for this kind of' adjustment mechanism are widely known, and is unrelated to the feature of' the present invention, so a detailed explanation is omitted here.

[0045] As described above, with the front end section of the steering column 6a supported by the support bracket 14a, components of an electric power-steering apparatus, in other words, heavy object such as the housing 9a that houses a reduction gear and the like, an electric motor 10a that is mounted around the housing 9a, a controller 46 and the like are arranged between the first side plate section 19 and the second side plate section 20 with regard to the width direction of the support bracket 14a as illustrated in FIG. 13. The height dimensions h_{19}, h_{20} of these side plate sections 19, 20 are sufficiently maintained, so strength and rigidity of the side plate sections 19, 20 for supporting the heavy objects are sufficiently large. Therefore, it is possible for the front end section of the steering column 6a to be supported by the vehicle body by way of the support bracket 14a with sufficient rigidity maintained, and so there is no occurrence of unpleasant vibration or noise in the support section of the steering column 6a due to vibration that is applied while the vehicle is traveling. In the case of the structure illustrated in FIG. 10, the electric motor 10a is such that the direction of the center axis is in an orthogonal direction to the center axis of the steering column 6a, and the electric motor 10a is located above the steering column 6a. However, the installation direction of the electric motor 10a could be inclined with respect to the center axis of the steering column 6a, and the electric motor 10a could be located lateral to or below the steering column 6a.

[0046] Furthermore, the support bracket 14a, as described above, is such that the blanking characteristics of the metal plate that will become the raw material are devised; and the support bracket 14a is manufactured as a single piece by performing punching and bending of the metal plate in a state where the amount of wasted material is kept to a minimum, so it is possible to keep manufacturing costs of the support bracket 14a low.

[0047] Particularly, in the structure of this example, the components of an electric power-steering apparatus are placed at a position offset further to the side of the second side plate section 20 than the center position of the portion between the side plate sections 19 and 20 (nearer the left in FIG. 10, and nearer the right in FIG. 13). To correspond with this, the position of the second front installation plate section 21b that is formed on the edge section of the top end of the second side plate section 20 is also offset with respect to the center position in the width direction of the support bracket 14a. That is, in this example, the installation position of the components of the electric power-steering apparatus that includes the electric motor 10a is offset, and by devising the position of the component parts of the support bracket 14a to correspond with this, it is possible to improve the blanking characteristics and to sufficiently reduce the cost of the support bracket 14a.

[Industrial Applicability]

[0048] The example in the figures illustrates a structure in which the present invention is applied to an electric power-steering apparatus in which not only a tilt mechanism for adjusting the up-down position of the steering wheel is assembled, but also a telescoping mechanism for adjusting the forward-backward position is assembled. However, a premise of the present invention is the

structure for supporting the front end section of the steering column by a support bracket, so when embodying the present invention, it is possible to omit the telescopic mechanism, or to even further, omit the tilt mechanism.

[Explanation of the Reference Numbers]

[0049]

1	Steering wheel
2	Steering gear unit
3	Input shaft
4	Tie rod
5, 5a	Steering shaft
6, 6a	Steering column
7a, 7b	Universal joint
8	Intermediate shaft
9, 9a	Housing
10, 10a	Electric motor
11	Vehicle body
12, 12a	Pivot shaft
13	Rear support bracket
14, 14a	Support bracket
15	Base plate section
16a	First rear installation plate section
16b	Second rear installation plate section
17	First extended section
18	Second extended section
19	First side plate section
20	Second side plate section
21a	First front installation plate section
21b	Second front installation plate section
22	Flat plate section
23	Inclined plate section
24	Column support bracket
25	Bolt
26	Through hole
28	Through hole
29	Inclined plate section
30	Tip end plate section
31	Reinforcement rib
32	Circular hole
33	Intermediate material
34	Raw base plate section
35	First raw extended section
36	Second raw extended section
37	First raw side plate section
38	Second raw side plate section
39	Outer column
40	Inner column
41	Long hole in the forward-backward direction
42	Cylindrical member
43	Long hole in the up-down direction
44	Adjustment rod
45	Adjustment lever
46	Controller
47a	First reinforcement plate section
47b	Second reinforcement plate section

Claims

1. A support bracket for supporting a steering column made by punching and bending a metal plate into a single piece having a left and right asymmetrical shape, and comprising:

   a base plate section that is provided in the width direction on a rear end section of the support bracket;
   a pair of left and right rear installation plate sections that are provided on both end sections in the width direction of the base plate section;
   a first extended section and a second extended section that extend forward from the edge on the front end of these rear installation plate sections;
   a first side plate section that is bent upward from an edge on the inside in the width direction of the first extended section;
   a second side plate section that is bent upward from an edge on the outside in the width direction of the second extended section;
   a first front installation plate section that is provided in a state of being bent outward in the width direction from the edge on the top end of the first side plate section; and
   a second front installation plate section that is provided in a state of being bent outward in the width direction from the edge on the top end of the second side plate section

2. The support bracket according to claim 1 further comprising:

   a first reinforcement plate section that extends downward toward the front from an edge on the front end of the first front installation plate section, and has an edge on the rear end that is continuous to the edge on the front end of the first front installation section by way of' a bent section, and an edge on the end in the width direction that is continuous to an edge on the top end of the first side plate section by way of' a bend section; and
   a second reinforcement plate section that extends downward toward the rear from an edge on the rear end of the second front installation plate section, and has an edge on the front end that is continuous to the edge on the rear end of the second front installation plate section by way of a bent section, and an edge on the end in the width direction that is continuous to an edge on the top end of the second side plate section by way of a bent section.

3. The support bracket according to claim 1, wherein circular holes for supporting a pivot shaft for support-

ing the steering column are formed in the front end sections of the first side plate section and second side plate section.

4. The support bracket according to claim 1, wherein the front end section of the second side plate section is offset inward in the width direction, and the space between the front end sections of the first side plate section and second side plate section is more narrow than the space between the middle sections and rear sections of the first side plate section and the second side plate section.

5. The support bracket according to claim 4, wherein the front end section of the second side plate section is continuous with the middle section in the forward-backward direction of the second side plate section by way of an inclined plate section, and
a reinforcement rib that protrudes inward in the bending direction is provided in the middle section in the up-down direction of a bent section where the middle section of the second side plate section and the inclined plate section are continuous.

6. A manufacturing method for the support bracket according to claim 1 comprising the steps of:

forming an intermediate material that has an overall flat shape by stamping out this intermediate material from a raw material that has a flat shape, the intermediate material comprising: a raw base plate section that exists in a portion that corresponds to the base plate section; a first raw extended section and a second raw extended section that extend forward from edges on the front end of end sections on both the left and right sides of the raw base plate section; a first raw side plate section that extends from an edge on an inside in the width direction of the first raw extended section to the center side in the width direction; and a second raw side plate section that extends from an edge on the outside in the width direction of the second raw extended section to the outside in the width direction; and
bending a base end section of the first raw side plate section with respect to the first raw extended section, and bending a base end section of the second raw side plate section with respect to the second raw extended section in the same direction in a thickness directions of the intermediate material to form the first side plate section and the second side plate section, and bending end sections in the width direction of the first side plate section and second side plate section to the outside in the width direction of the intermediate material in opposite directions from each other to form the first front installation plate section and the second installation plate section.

7. The manufacturing method for a support bracket according to claim 6, wherein, with reference to the width direction of the intermediate material, the distance from a bent section between the base end section of the first raw side plate section and the first raw extended section to an edge on the inside in the width direction of the first raw side plate section is greater than the distance from a bent section between the base end section of the second raw side plate section and the second raw extended section to an edge on the outside in the width direction of the second raw side plate section

8. An electric power-steering apparatus, comprising:

a steering column;
a housing that is connected to the front end section of' the steering column and in which or on which components of the electric power-steering apparatus are mounted; and
a support bracket that supports and fastens the front end section of the steering column to the vehicle body by way of the housing, wherein
the support bracket is the support bracket according to claim 1

9. The electric power-steering apparatus according to claim 8, wherein
the front end section of the steering column is supported by a pivot shaft that spans between the front end sections of the first side plate section and second side plate section so as to be able to pivotally displace with respect to the vehicle body.

10. The electric power-steering apparatus according to claim 8, wherein
the front end section of the second side plate section is offset inward in the width direction, and the space between the front end sections of the first side plate section and the second side plate section is more narrow than the space between the middle sections and the rear sections of the first side plate section and second side plate section, and the component parts are arranged between the middle sections and the rear sections of the first side plate section and the second side plate section.

11. The electric power-steering apparatus according to claim 10, wherein
the component parts are located at a position offset more toward the side of the second side plate section than the center position in the width direction of the space between the first side plate section and the second side plate section.

Fig.1

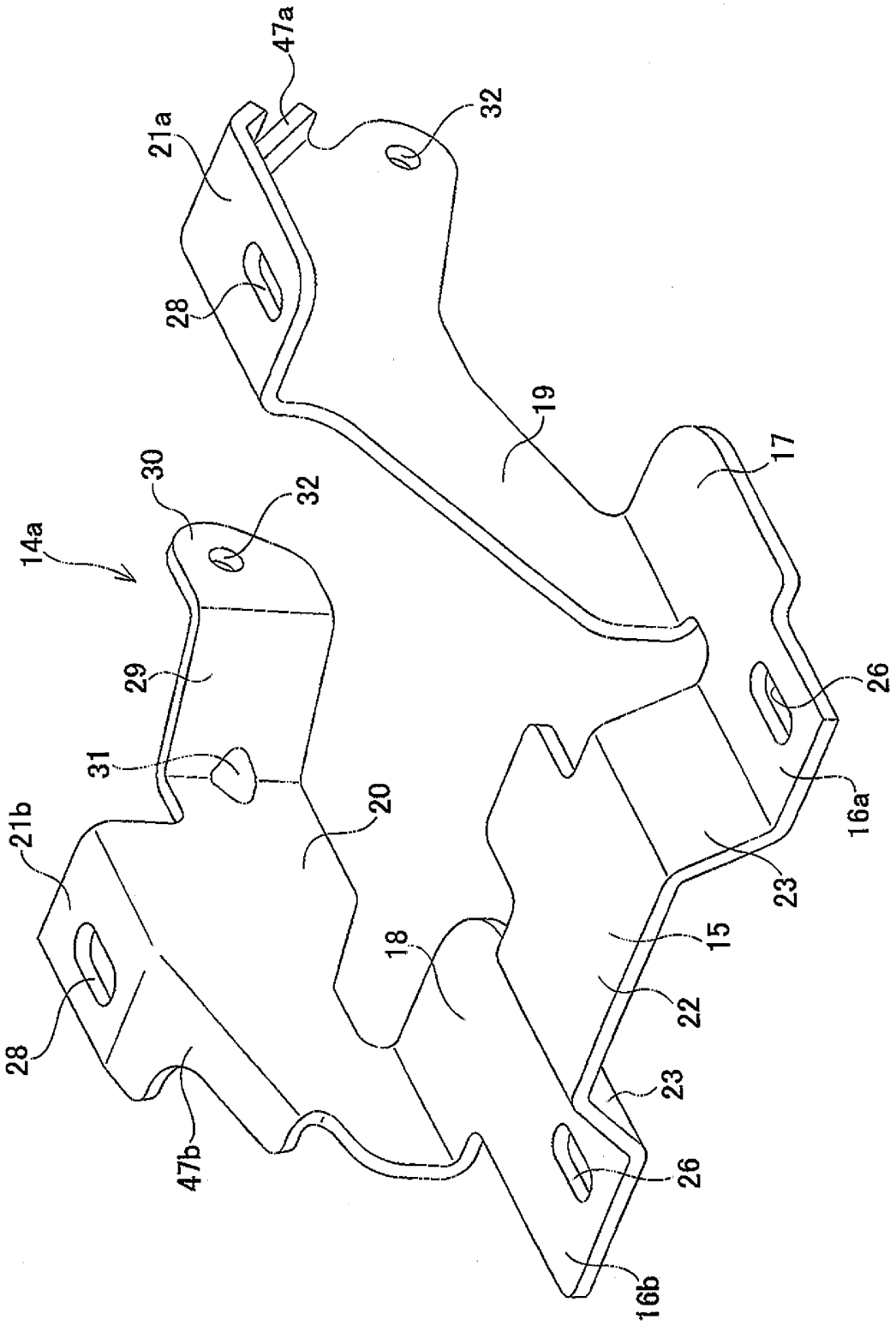

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Fig.2

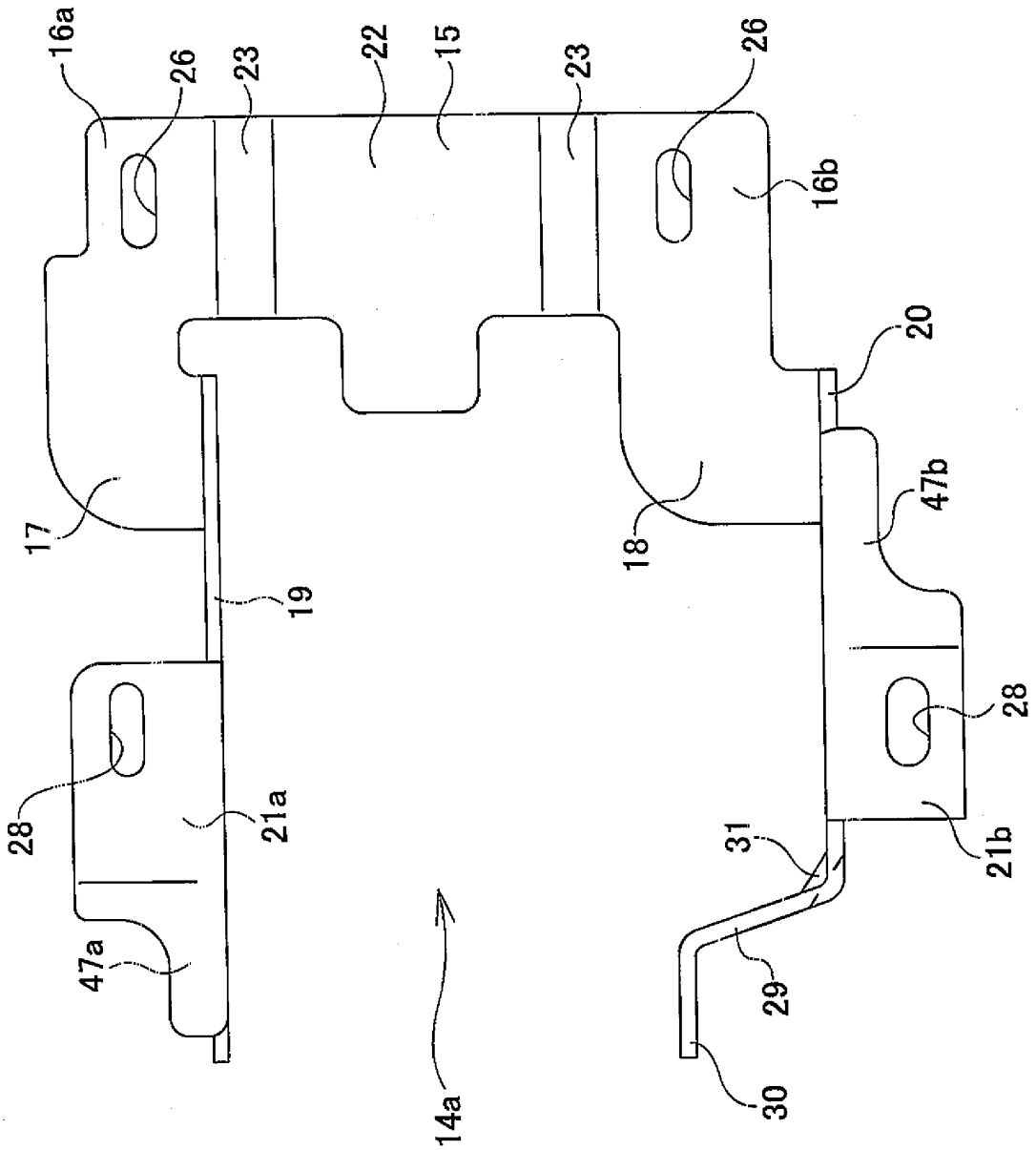

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Fig.3

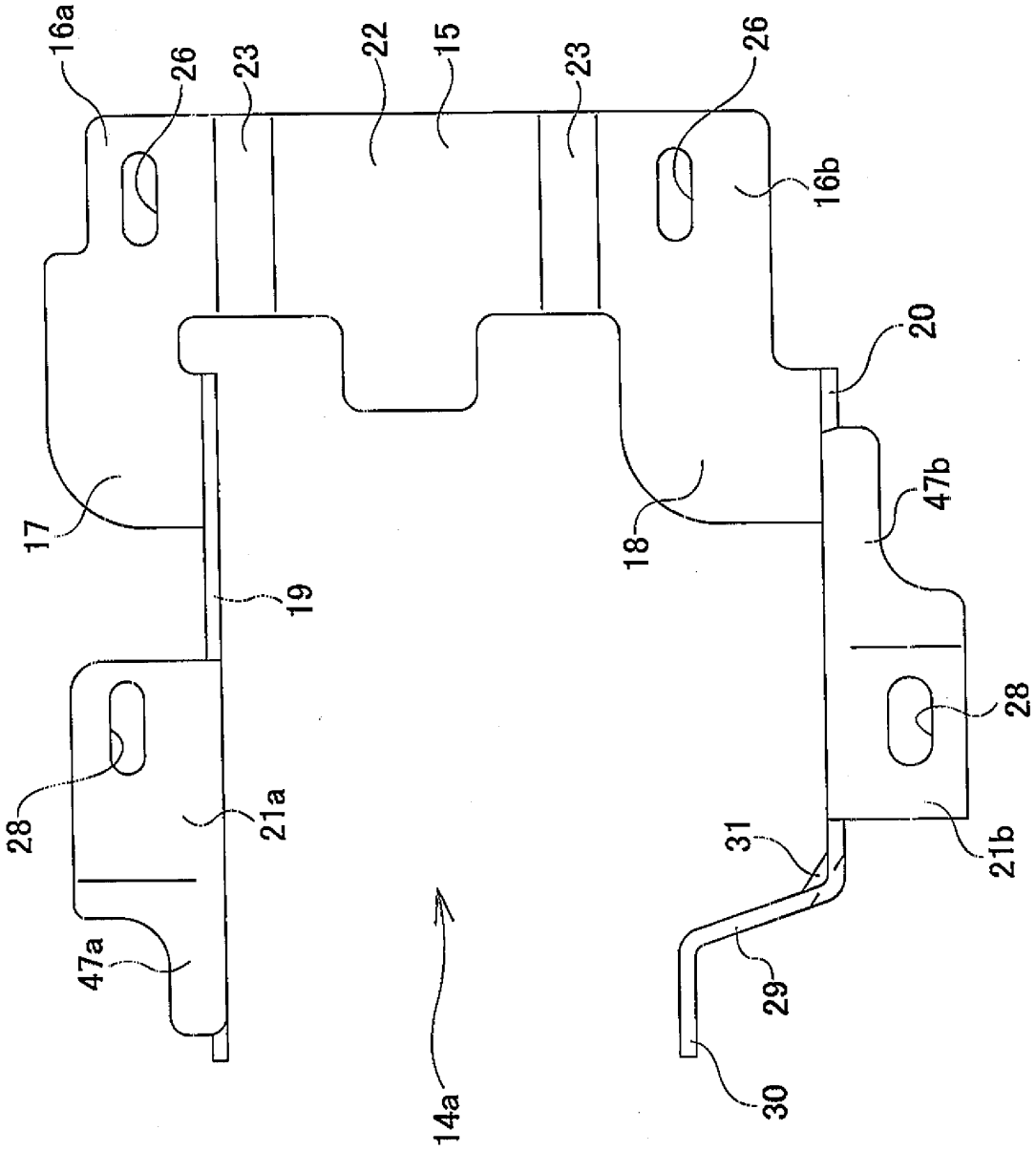

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Fig.4

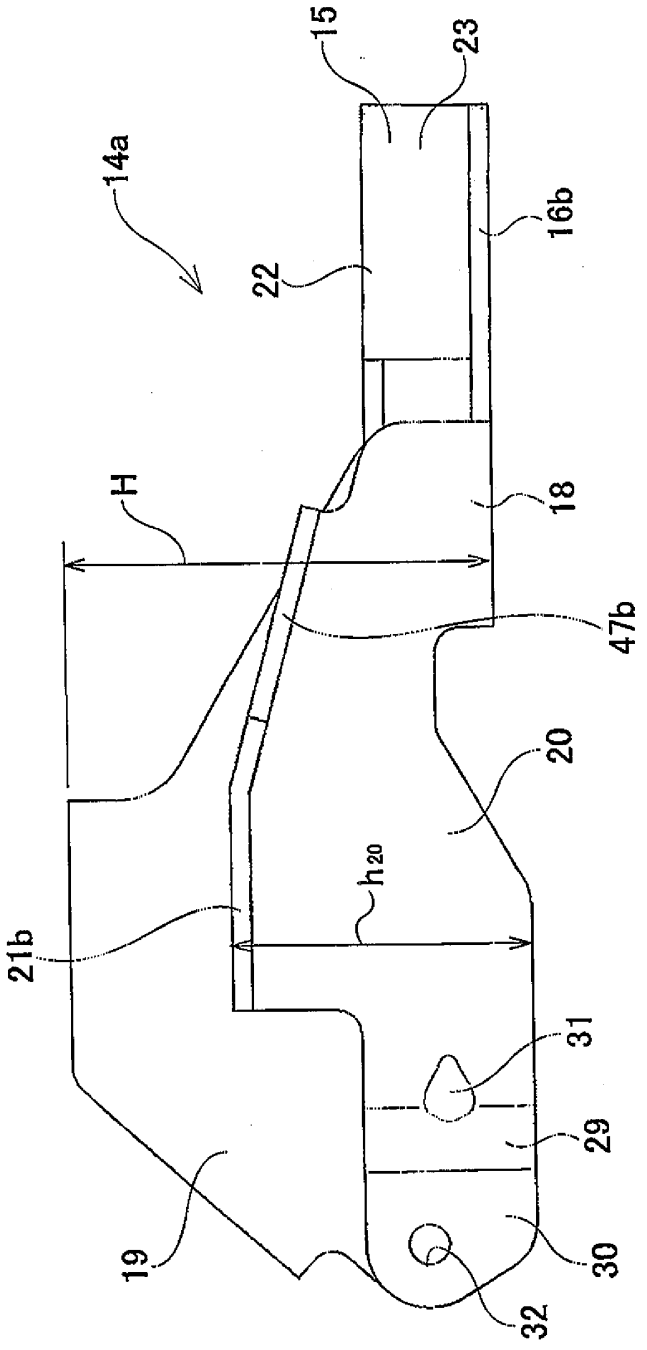


Fig.5

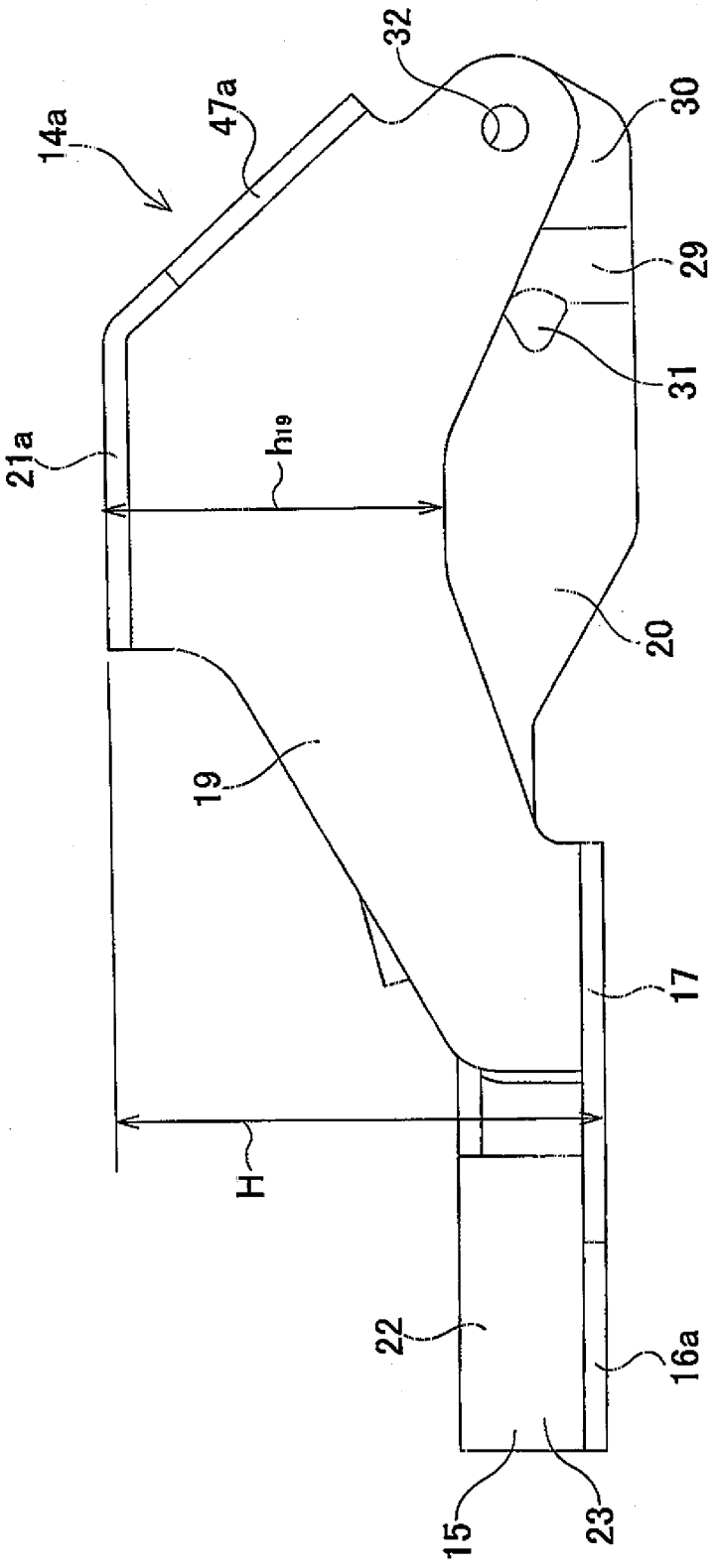
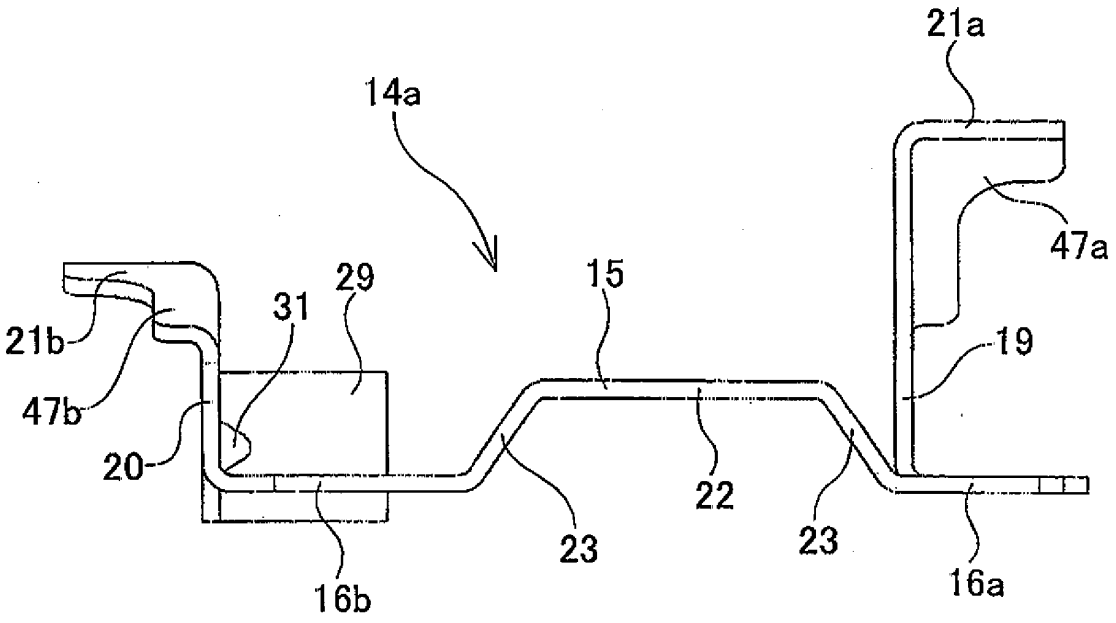


Fig.6



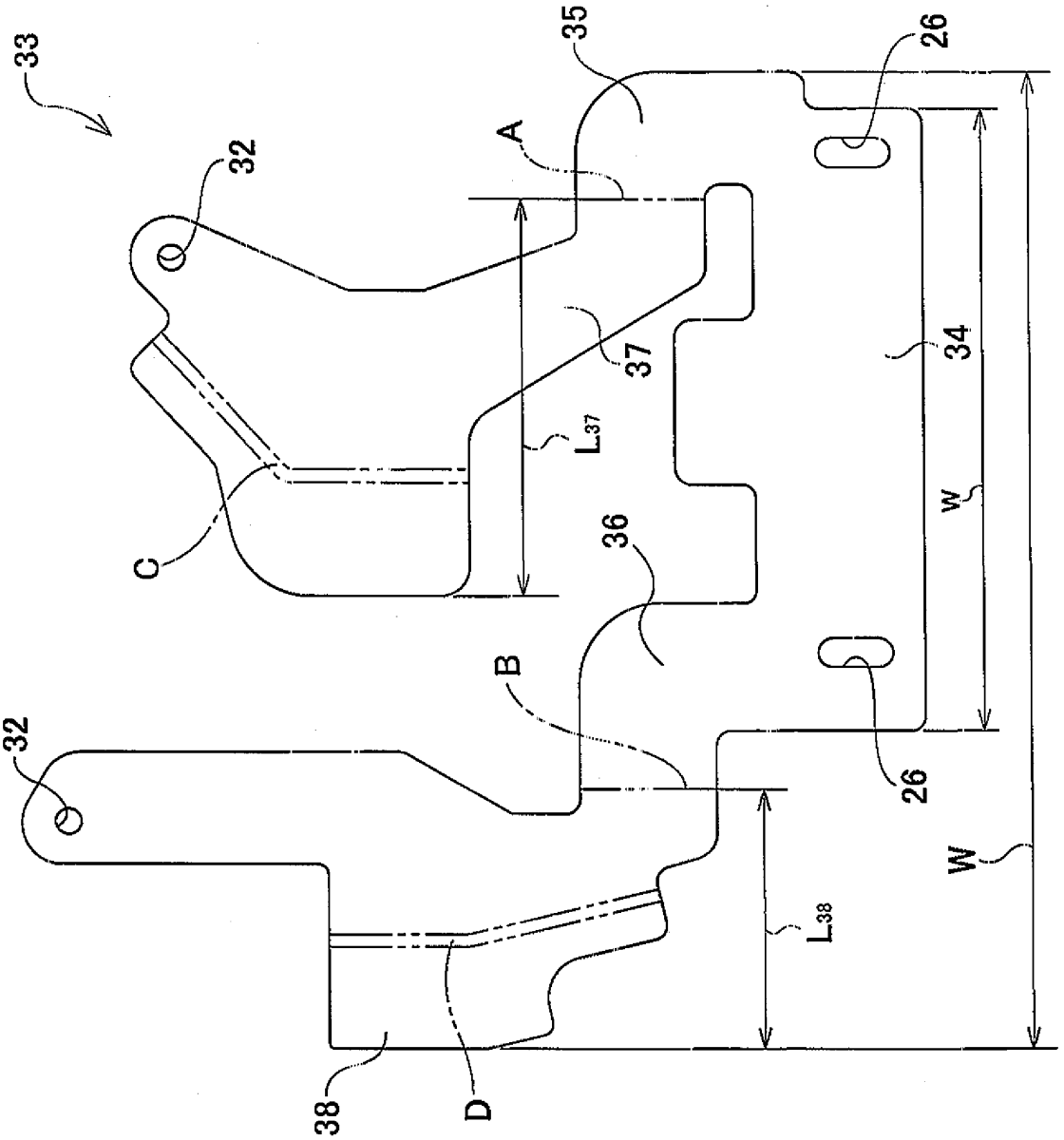


Fig.7

Fig.8

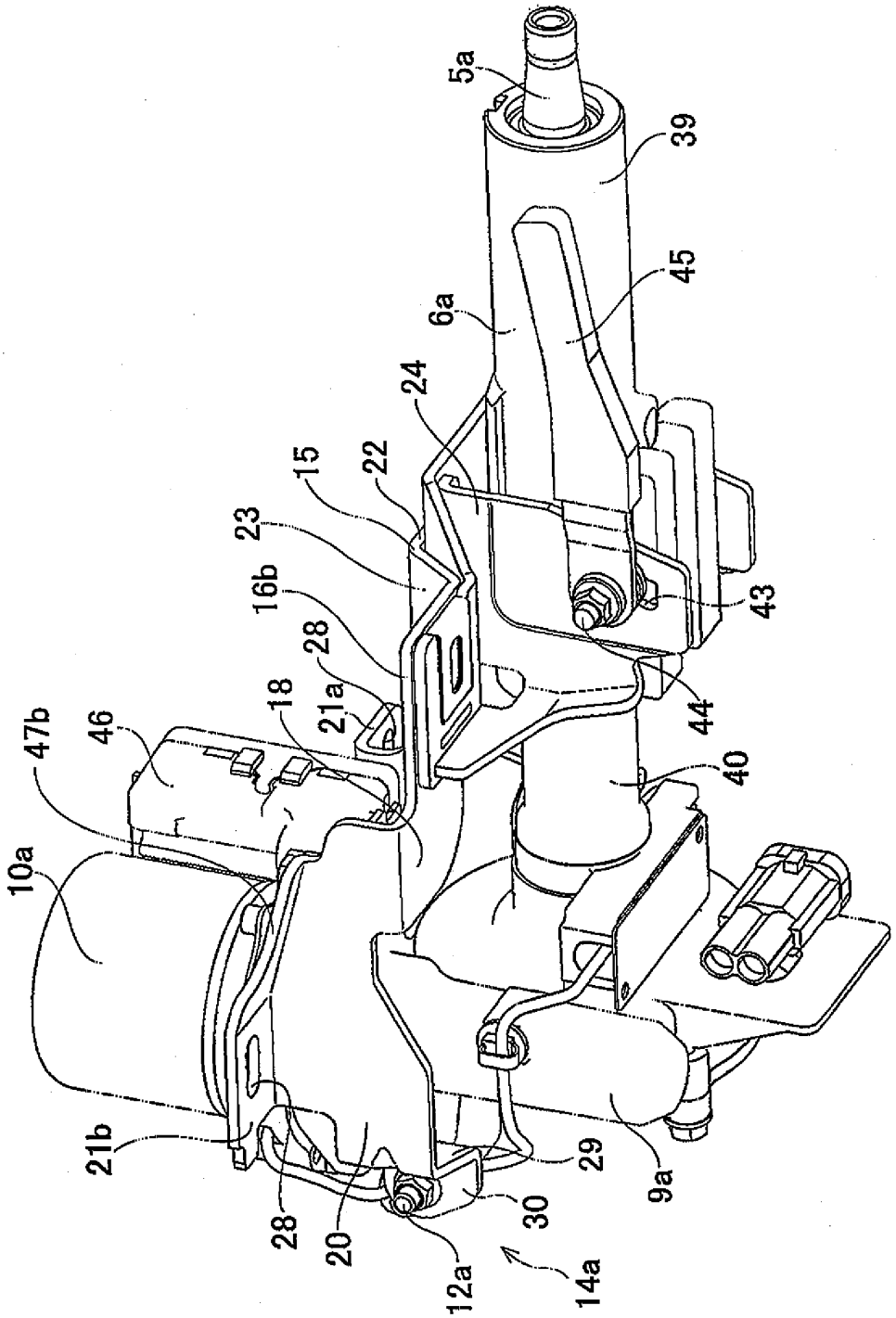

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Fig.9

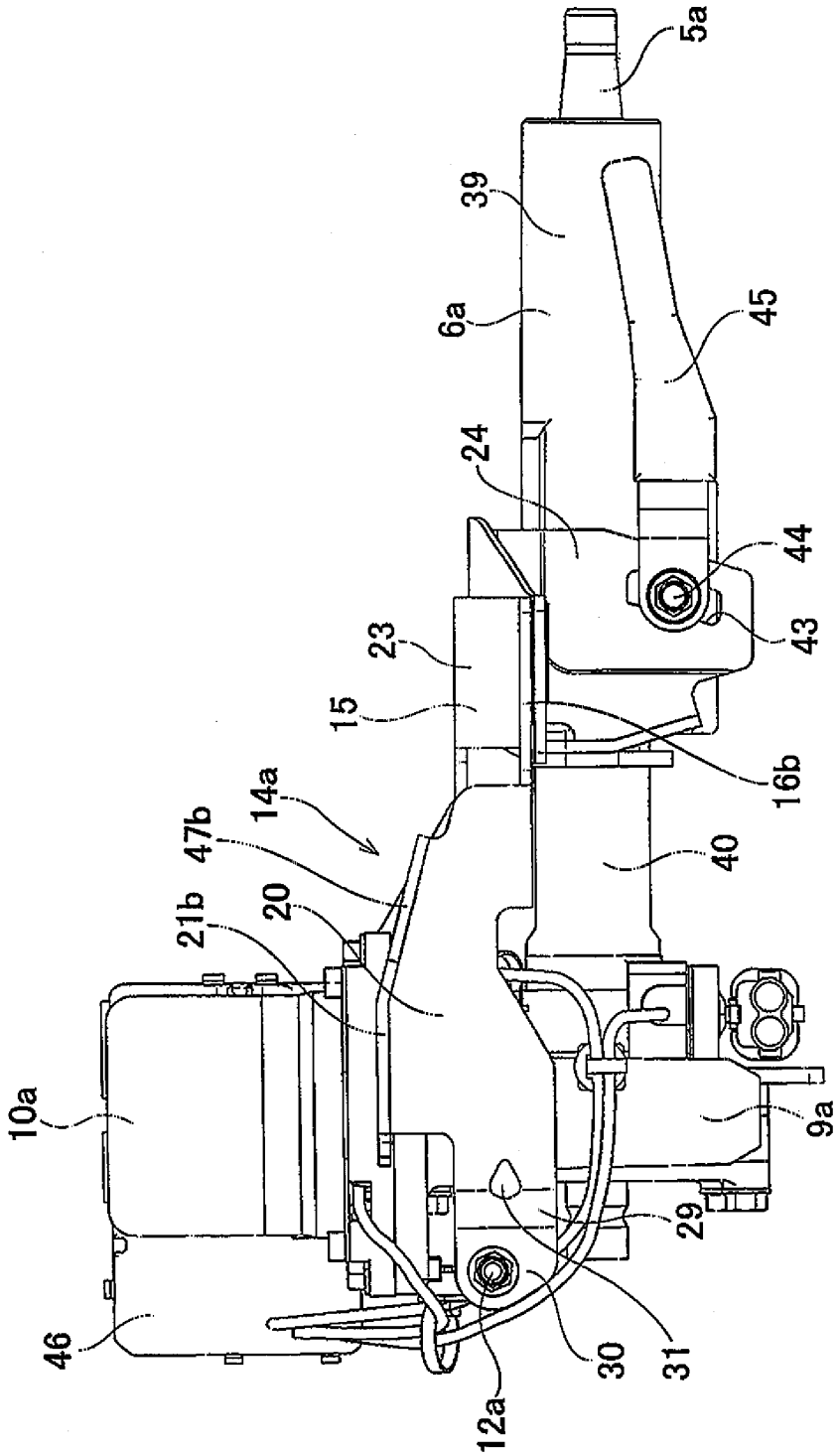

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Fig.10

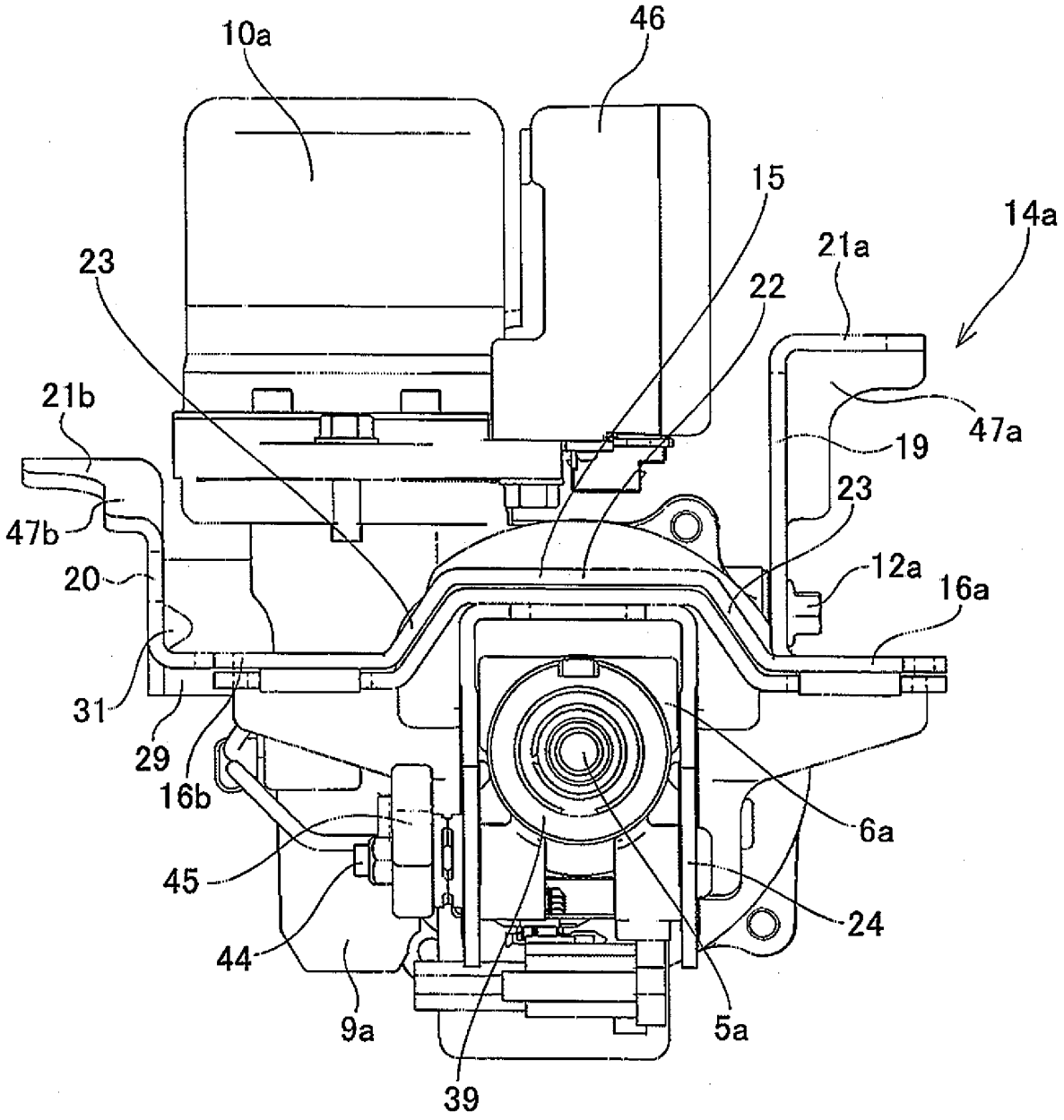

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Fig.11

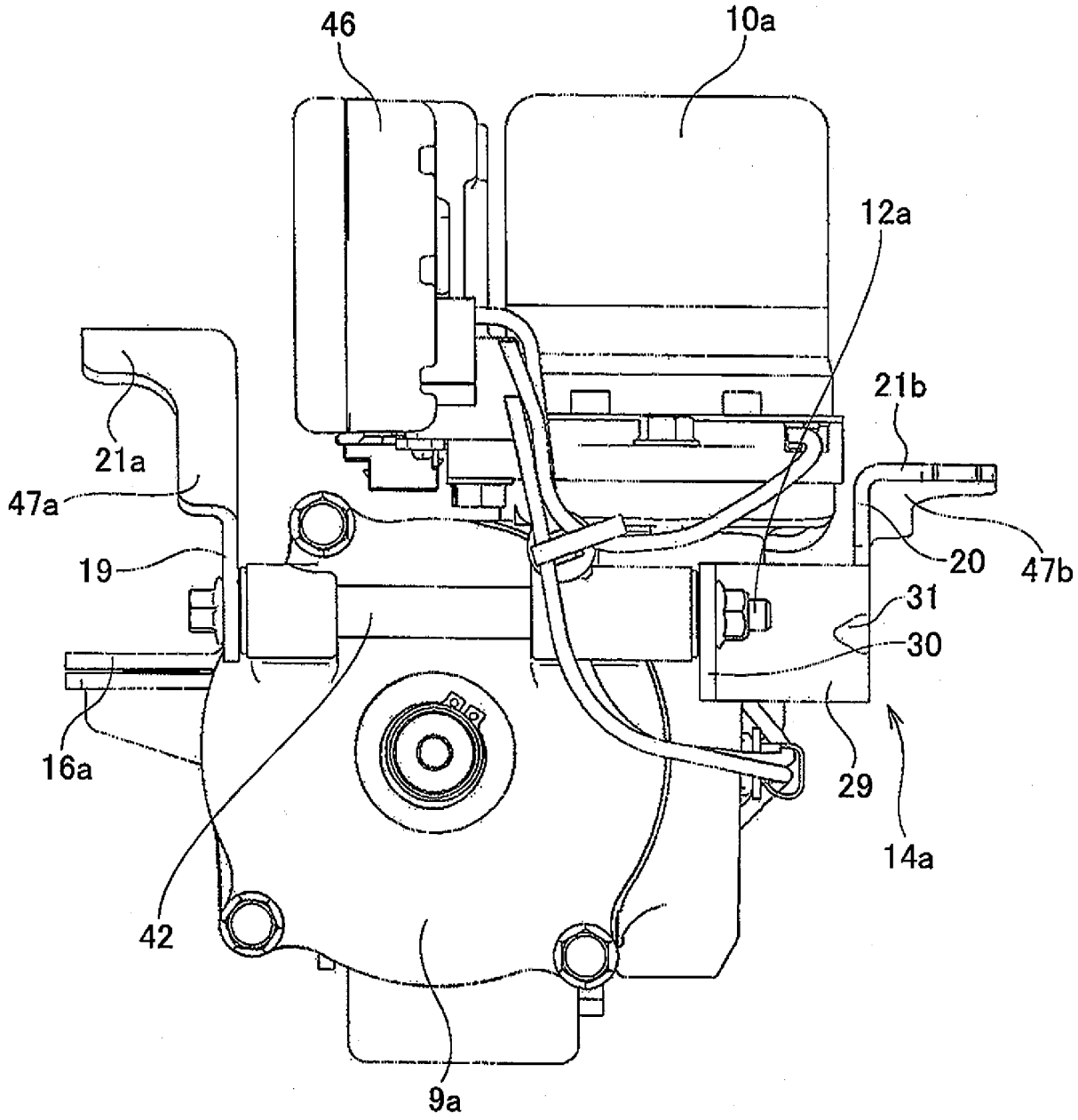


Fig.12

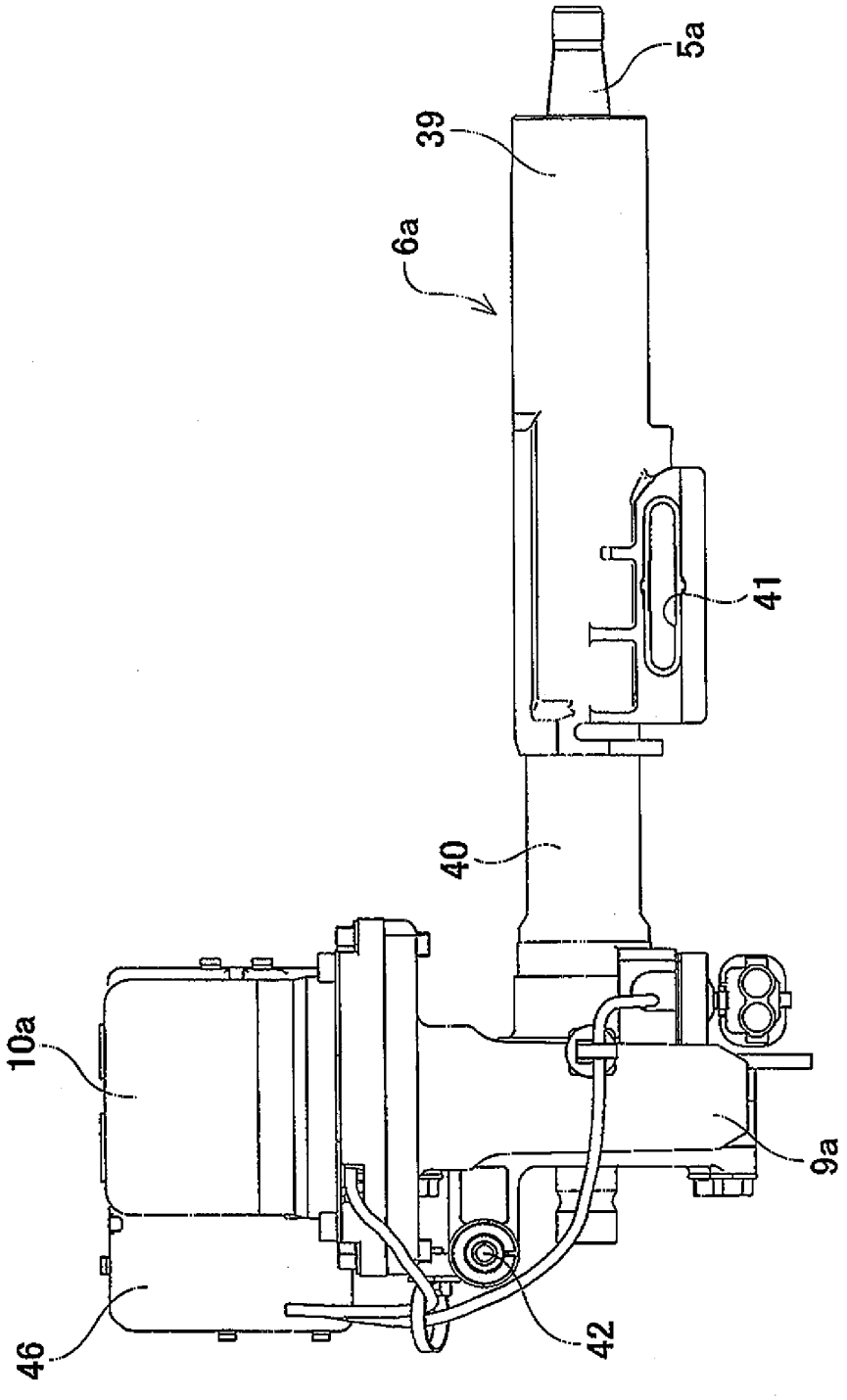
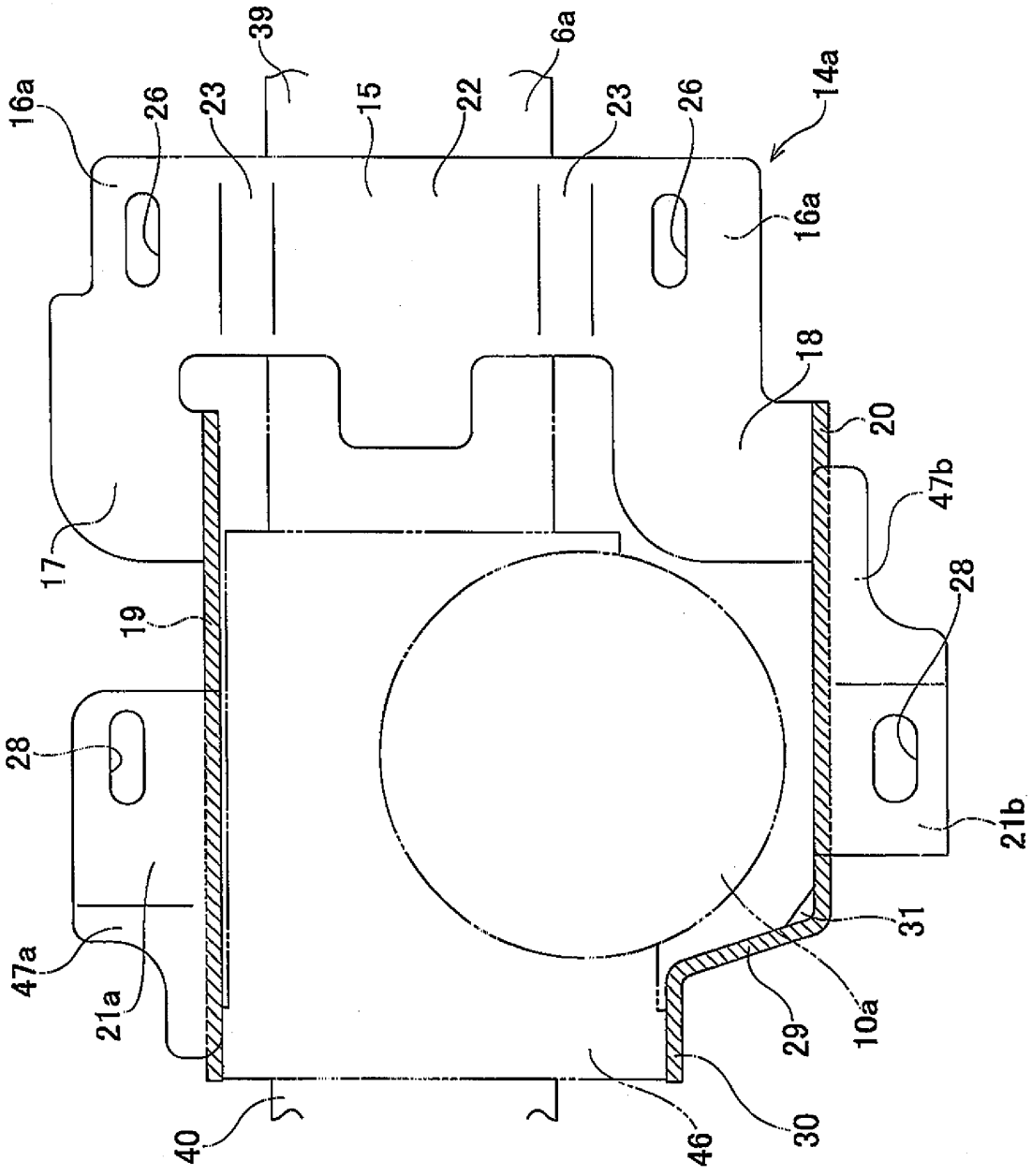


Fig.13


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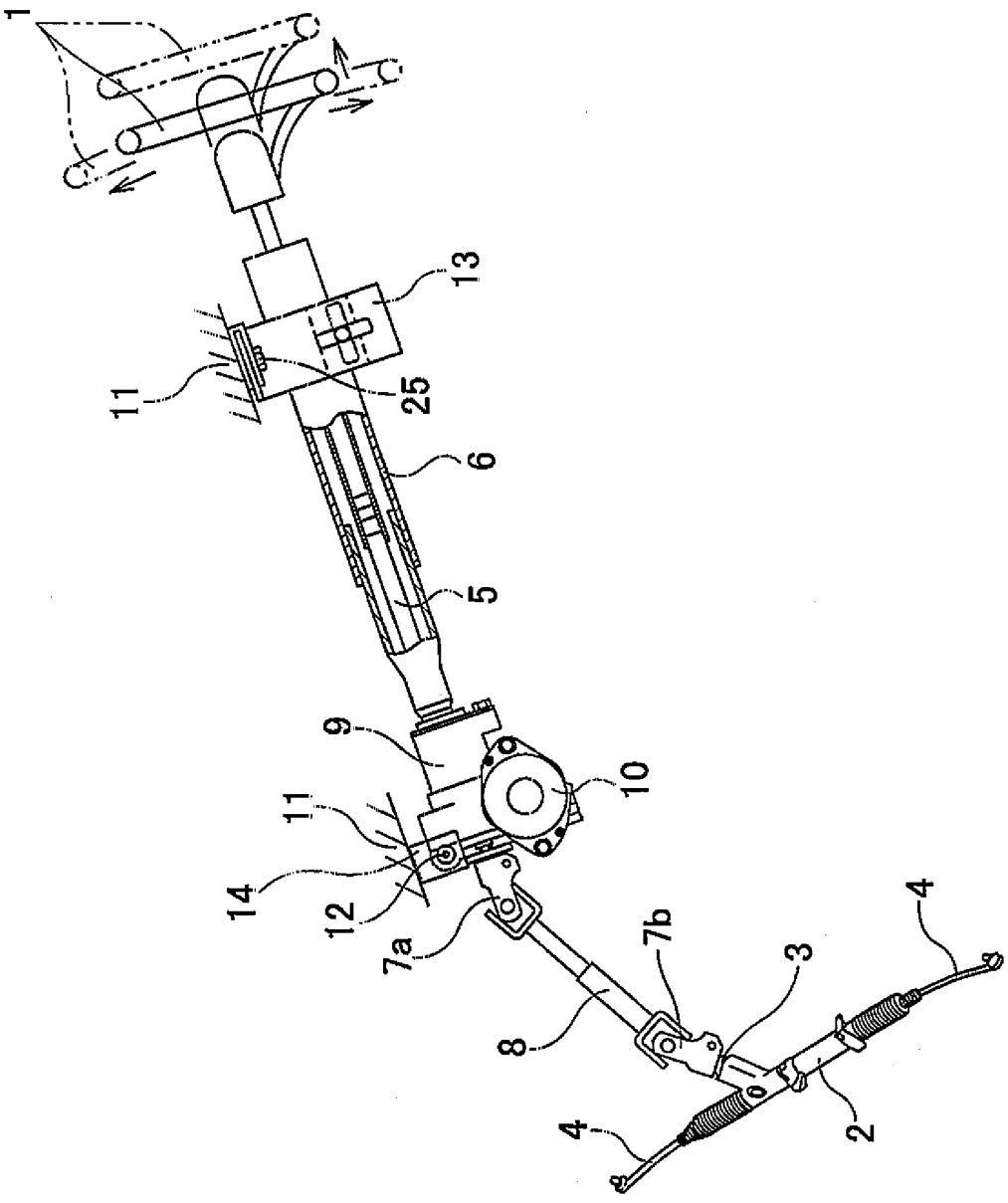


Fig.14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/068579

A. CLASSIFICATION OF SUBJECT MATTER
B62D1/18(2006.01)i, *B21D53/88*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B62D1/18, B21D53/88

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2003-26004 A (Nissan Motor Co., Ltd.), 29 January 2003 (29.01.2003), claims; paragraphs [0001] to [0061]; fig. 1 to 5 (Family: none)	1,3,8 4,9-11 2,5-7
Y A	JP 2001-55151 A (Koyo Seiko Co., Ltd.), 27 February 2001 (27.02.2001), claims; paragraphs [0001] to [0061]; fig. 1 to 13 (Family: none)	4,9-11 2,5-7
A	JP 2011-131682 A (NSK Ltd.), 07 July 2011 (07.07.2011), entire text; all drawings (Family: none)	1-11

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 October, 2012 (16.10.12)	23 October, 2012 (23.10.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/068579

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2005-219641 A (NSK Ltd.), 18 August 2005 (18.08.2005), entire text; all drawings (Family: none)	1-11

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2011131682 A **[0002]**
- JP 2005219641 A **[0004] [0005]**
- JP 2011181682 A **[0005]**